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A Facial Emotion Recognizer Based on Convolutional Neural Networks using Transfer learning

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ABSTRACT: Facial Emotion Recognition (FER), one of the most recent popular researchareas in the field of Computer vision, it is the task of detecting emotion by analyzing facial expressions and this task plays a critical role as it tells the clearest information regarding the emotions of people. The efficiency was found by experiments conducted on a widely-used dataset. According to the experimental results, the accuracy of Our Project was calculated to be as high as 87.68%. The experimental results confirmed that this neural network architecturemodel is fast enough to be integrated into real world FER applications as it is able to detect emotions with good accuracy.

INDEX TERMS: Artificial intelligence, Computer Vision, Artificial Neural Networks,Backpropagation, Multi-Layer Neural Network, Neural Networks, Supervised Learning, Convolutional Neural Network.

I. INTRODUCTION

Human expressions and emotions play a vital role in Emotional Recognition. One's expression helps to know the mood of the human. There are many ways to inspect the recognition of human expressions by their final expressions, voice tone and body language, etc. In this proposed work, we have focused on facial expression recognition. "A facial expression recognition system is an automated systemthat can analyse the features of a face froma static image".In the case of FER, it is able to extract features is a key aspect considering the fact that classification mainly depends on the shape and location of facial features such as the eyes, mouth, nose and eyebrows. FER modeltakesthe photos of subjects as the input and producethe detected emotionsthrough various analysis as the output. The target emotion of the model which could be happiness,sadness, surprise, anger, disgust, fear, contempt, and neutral. The general architecture of FER approaches contains three phases,namely,
(1) pre-processing the input (2)main features extracting and (3) classification phase of the input. In the pre-processing phase, the quality of the input images is modified and repeated information is removed. In the feature extraction phase, the input data that is pre- processed are transformed into the best representable features in order to achieve agood classification technique that could perform the right predictions in terms of emotions. In the last phase, the classification of input phase,mapping of inputs to target list emotions takes place byvirtue of the built classification model.

The main findings of this study are listed asfollows:

The proposed architecture (including all the pre-processing tasks) was implementedusingopensource software (e.g. some python libraries like OpenCV,Tensorflow,Numpy) which makes the building of the model possible and easy. Thanks to the implemented automated tasks, the effect of various hyperparameters on the proposed convolutional neural network model were experimented, and the one that provides the best accuracy were revealed.Theexperiences which were experimented during the optimizing of this proposed architecture on the cross- validation set were listed in order to share the 'lessons learnt' as a good contribution to the field.

II. RELATED WORK/ EXISITING SYSTEM

Facial Expression Recognition has receivedattention during the last 2 decades. Therationale for facial expression recognition based on motion can be derived from studies in psychology. Research done by Psychologist Mehrabian

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shows that only7% of the actual information is received byoral means and 38% passes by the auxiliary of the languages such as the rhythms and speed of the speech, tone, etc. The information which is received by the expression of the face has reached 55%. “In1872 Darwin announced the expression consistency. The expressionof the face cannot be estimated by the gender and raceof the person. Ekman and Friesen made a research work for recognizing the facialexpression and they defined to basic categories of facial expressions as” Happiness, Sadness, Surprise, Fear, Disgust and Anger, Neutral”.Such investigations have shown that at any rate 7 feelings are generally connected with unmistakable outward appearances anger, fear, disgust, happiness, sadness, surprise and neutral. Most mental investigations of outward appearances have utilized mug-shot pictures that catch the statement of the subject at its pinnacle Just a couple of studies have explored the impact of movement and twisting of facial highlightson the understanding of outward appearances. Bassili recommended thatmovement in the picture of a face could permit feelings to be distinguished even with the negligible course of action of the highlights. In the engineering literature, early efforts were based on analysis of the optical flow field of the image sequence, which provides clues to the spatial changes in the facial features. This demonstrated successful facial emotion recognition in extensive lab experiments involving some subjects as in television and movie sequences. In principle, facial expression recognition can be integrated into a face recognition system so the system is robust to expression variations. In practice, however, it seems that moderate, non- dramatic expressions can be handled bymany existing face recognitionsystems.

III.MATERIAL AND METHOD/PROPOSED SYSTEM

DATASET: The dataset of our project contains a greatvarietiesof photosof both genders with varying ages having different background. The sizes of the photos in this dataset are 75*75 pixels. The datasetcontains only grayscalephotos.Eachimageiscategorized intooneofthesevenfacialemotionswhichare(1)Anger,(2)Disgust,(3) Fear, (4) Happiness, (5) Sadness, (6) Surprise, and (7) Neutral.

III. PROPOSED ARCHITECTURE

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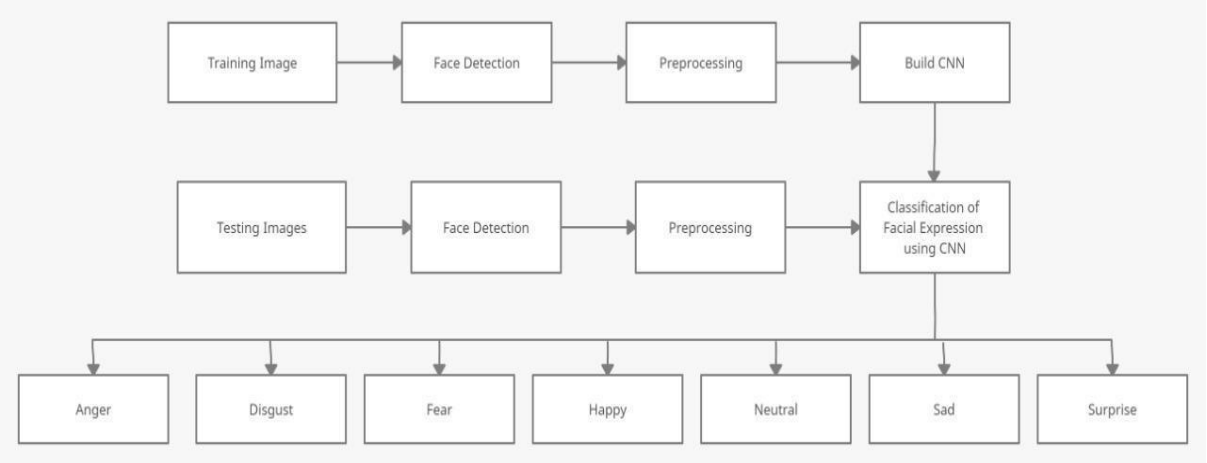
Our Project was mainlydesignedto efficiently classify given input images into seven facial emotions, namely (1) Anger, (2) Disgust, (3) Fear, (4)Happiness,(5)Sad,(6)Surprise,and (7)Neutral. It is light weight to make it possible to be used on machinerieswith less computationalpower.Our Project was implemented using convolutional neural network in Python programming language with the help of library Tensorflow. Our Project consists of three phases: (1) In the phase one, the input images are pre-processed like normalization and resizing (2) the phase two contains the traditional CNN layerssuch as convolutional,pooling and dropoutlayers to perform convolution functions over the input data, and (3) the phase three is where the classification of input occurs by the help of the fully connected layers with activation functions like relu andsoftmax.



This Picture depicts the entire process .

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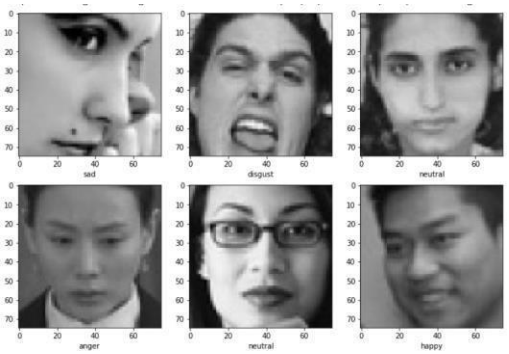

The data set of our Project

IV. HARR-CASCADE CLASSIFIER

OpenCV comes with a trainer also as a detector. Here we deal with detection of given images. Each phase is described in the detail: In the pre-pro-processing stage the given input images in grayscale form are scaled to 75×75 pixels to decrease the complexity of the input data as well as the computational power required. In the second stage, each pre-processed image is passed through the convolutional layers.

Each convolutional layer was followed bythree components:

(1) ReLU activation function that is used to avoid the vanishing gradient problem as a result of some other activationfunctions

(2)Batch Normalization, which is a method that can be applied to any set of activation functions in the neural network in order to normalizethe output data of each activation by themean and standard of deviation oftheoutput data's calculated over the samplesineach minibatch.

(3) Dropout which is atechnique that deals with the commonproblem of neural networks knownas theoverfitting problem, as a result of increasing depth and complexity of deep neural networks. Dropout randomly dropssome neurons from the neural networkduring training in order to prevent overfitting problem. OpenCV already containsmany pre-trained classifiers for face,smile,etc.

Haar-Cascade Classifier is loaded as follows:

Import

numPy as np

Import cv2

Face_classifier=cv2.CascadeClassifier("haarcascade_frontalface_default.xml")

import image to array. Frame cap.read() Gray=cv2.cvtcolor(frame,cv2.COLOR_B GR2GRAY the appearances are presently recognized by the Haar-Cascade classifier which stores the situation of identified faces as Rect(x,y,w,h).

```
accu=model.evaluate(x_val,Y_val)
print("Loss = ",accu[0],"Accuracy = ",accu[5])
```

```
120/120 [==============================] - 5s 39ms/step -
Loss =  3.580003023147583 Accuracy =  0.8782706260681152
```

V. CONVOLUTIONAL NEURAL NETWORK

Convolutional neuralsystem(CNN) as appeared in below image might be an extraordinary kind of feedforward neural system initially utilized inside the PC vision field. Its structure is propelled bythehumansvisual regions, a noticeable instrument inside the creature mind. The visual area contains tons of cells that are responsible for detecting light in small and overlapping subregions of the vision fields, which are called receptive fields. These cells actsas the local filter over the input space. CNN comprises of various convolutional layers, every one of which plays out the capacity

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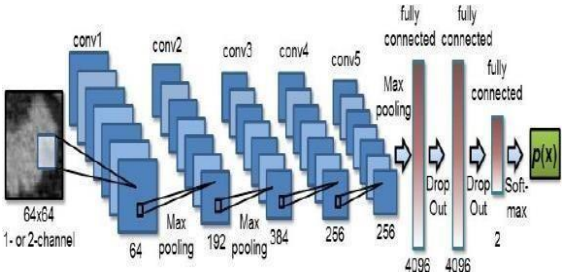
that is handled by many cells inside the visualzone.



The working picture of Convolutional Neural Network

VI. CLASSIFICATION

Image processing involves some basic operations namely image resizing, image enhancement, imageclassification , etc. Image classification forms a crucial a part of image processing. The target of image classification is that the automatic allocation of the image to their classes. Two sorts of classification are supervised and unsupervised. The strategy for picture characterization includes twostages, preparing of the framework followed by testing. The preparation procedure implies, to require the trademarkproperties of the photos (structure a class) and structure a particular depiction for a particular class. The technique is finished for all classes relying on the kind of arrangement issue; double order or multi- class grouping. The testing step intends to arrange the test pictures under different classes that the framework was prepared. Several definitions are available for Deep Learning; coating one among the various definitions from Deep Learning is defined as: a subcategory of machine learning techniques that exploits many layers of nonlinear information science for supervised or unsupervised feature extraction and transformation and for pattern analysis and classification. This work aims at the appliance of CNN for image classification. In this proposed work faces are detected and emotions are recognized as Happiness, Sad,Anger,Fear,Neutral,Disgust and Surprise by CNN.The detected Emotions work are often extended to more applications just like the industry can use this face recognition for his or her employees. Education institutionscan adapt this face recognition expression analysis system for his or her studentsattendance or for something else. The Media can use this technique to understandthe general public opinion before polling topredict the election results. The business organizations can use this to know their customer emotions for their products like whether they are satisfied with the product ornot.

VII. EXPERIMENTAL RESULT AND DISCUSSION /IMPLEMENTATION

The proposed convolutional neural network architecture model, was evaluated fromthe dataset in order to find its efficiency. Before training the proposed deep convolutional neuralnetworkwhich uses transfer learning in which we have used InceptionResnetV2 with pretrained weights, top=False and layers trainable as true,all the images in the dataset were cropped in order to remove the repeated backgrounds using OpenCV face detection function, namely, opencv - python. The dataset used contains 37800 images, and 80%, 20% of these images were used for training and validation purposes, respectively. The images in the dataset were shuffled. The proposed deep convolutionalneural network, was trained for around 300 epochs. Then, the training phase wasstopped, and the testing phase started. The performance of Our Project is given as follows: (1) The accuracy for detecting facial expressions on given photos, which is equal to the ratio of the total number of samples correctly classified to the total number of samples, and (2) the quick analysis time since FER applications need afast response as they are used in real-time systems. According to the experimental results, the accuracy of Our Project was calculated to be as high as 87.68. It was found that increasing the number of layers of the out neural network model did not improve the accuracy, and the hyper-parameters were all set by the conducted experiments.Proposingless weight model in order to complete the process with good accuracy for real-time applications is one ofthe main principles of Our Project. According to our experiment,ourmodel was able to detect the facial emotion of a given input photo with 87.68%accuracy.

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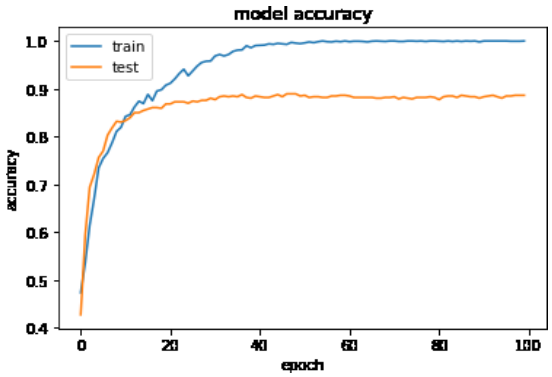

This shows the accuracy of the training and testing

VIII. CONCLUSION

Through deep learning, handling the problems, which cannot be handled by using traditional machine learning techniquesor theones thatwillnot yield great accuracy evenif handledbythattechniques, is possible. Convolutional neural networks, which is a part of deep feedforward neural networks, have yielded good performances in many cases in computer vision in the past years. The FERproblem case, which is an important research area of Computer Vision, is the process of detecting emotions by analysingfacial emotions by means of the advancement in both computer software and hardware. Finally,our model in this article whose efficiency was revealed by virtue of the experiments conducted on widely used benchmark dataset According to the experimental results, the accuracy ofour Project was calculated to be as high as 87.68%. Also, the experimental result confirms that the analysis period of Our model for a given input image is in the good limit for real word applications. In future, more efficient and good features can be added into the proposed model. Finally,more facial emotions can be targeted with the help of features mentioned above.

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